Diversity and evolution of the wood-decay apparatus in saprotrophic Agaricomycotina (or: how mushrooms changed the world).

The evolution of wood was a great innovation in plant evolution that enabled the formation of the world's first forests. Wood is a complex mixture of carbohydrates and lignin, which is a heterogeneous polymer that is a barrier to microbial decomposition. The principal wood decay organisms are Agaricomycetes (mushroom-forming Fungi), which attack wood through two mechanisms, termed white rot, in which all components of wood are decomposed, and brown rot, in which lignin is chemically modified but not appreciably degraded. Lignin is the major precursor of coal, which has prompted suggestions that the formation of vast coal deposits in the Carboniferous (and Permian) reflected the absence of white rot fungi throughout much of the Paleozoic. To reconstruct the evolution of wood decay systems, we are performing comparative genomic studies, emphasizing white and brown rot wood decay taxa, with a focus on gene families that encode enzymes involved in wood decay. Fungal class II peroxidases (fPOXs), which function in lignin degradation, are of particular interest. Analyses of a phylogenetically diverse suite of Agaricomycetes and other Fungi suggest that fPOXs began to diversify in the lineage leading to the ancestor of the Agaricomycetes and have expanded independently in multiple white rot lineages. Conversely, fPOXs have been independently lost from multiple brown rot lineages. Molecular clock analyses suggest that the initial diversification of fPOXs occurred around the end of the Permo-Carboniferous.